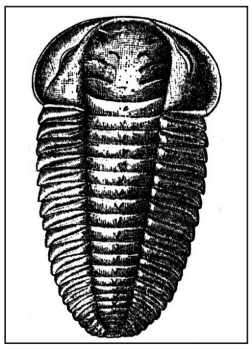

A History of Trilobites as "Living Fossils"

Linda A. Ritterbush

Deep down in each of us, even the most scientific straight arrow, is the desire to find an ostensibly extinct creature alive and well. Egged on by the well-known discovery of the coelacanth, or the less well-known *Neopilina*, we hope for the dinosaur in the Congo, or the plesiosaur in Loch Ness. As a trilobite paleontologist, I admit to the occasional fantasy of my boogie board pinning a rare but healthy scuttling three-lobed one.

None of these dreams is likely to be realized. On the other hand, such resurrections have been the hope of some "scientific creationists"—thus illustrating the lengthy historical continuum of a brand of obscure but fascinating reasoning. On an anecdotal level, I have been surprised by the number of "scientific creation" enthusiasts I have met, who, upon learning that I study trilobites, refer to them as *supposedly* extinct, or ask if I think they might one day be found alive, perhaps as "living fossils."

"Living fossils" is not, of course, a scientific term. In popular parlance, it means one of two things: either a taxon with a fossil record terminated before the present which is found (surprisingly) extant; or (less precisely) an organism with a long fossil record which appears morphologically nearly identical to its distant ancestors. Examples of the former include coelacanth fish and monoplacophoran mollusks; examples of the latter include certain sharks, and the inarticulate brachiopod *Lingula*.

Modern evolutionary theory does not find the presence of either version of the phenomenon disturbing. Because preservation of a fossil is an exceptional event, a taxon falling below a certain level of abundance is unlikely to leave a fossil record. Extant examples of this type of "living fossil" are likely to be "reclusive"—at low abundance, living in remote environments, or having an extremely limited geographic distribution in the present. Forms like *Lingula* exhibiting extreme morphologic conservatism over time are generally thought to be superbly adapted to a specific niche, which has been available throughout their geologic range.

Early European geologists, some of whom struggled mightily with the concept of extinction,[1] did not express such nonchalance. Seventeenth-century naturalist John Ray worried that extinction would imply an imperfect Creation, so he hoped seemingly extinct marine creatures would be found. British physician Robert Woodward was particularly perplexed by the giant coiled ammonoids. Perhaps, he explained, ammonoids were not truly extinct: they may yet prosper in some obscure environment, perhaps the deep sea. Living long before the aqualung and the deep-sea submersible, not to mention Robert Ballard, Woodward thought some future intrepid explorer would visit the depths and bring the ammonoids to light. It was not until eighteenth-century

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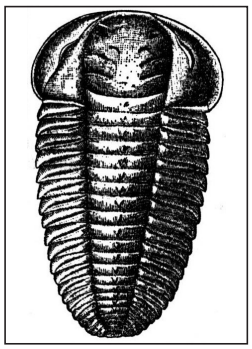


Communication

A History of Trilobites as "Living Fossils"

Lutheran pastor Byron Nelson, writing his 1931 The Deluge Story in Stone, *revived the living fossil argument, quoting a 1695 John Woodward treatise extensively. Nelson then introduced the trilobite as a likely candidate for rediscovery in the deep sea.*

French anatomist Georges Cuvier monographed mammoths and mastodons that the reality of extinction was accepted.

Enter the "scientific creationists" of the twentieth century. As elaborately detailed by Numbers,[2] the modern debut of deluge geology followed a two-step process: (1) the writings of Seventh-Day-Adventist founder Ellen White, and subsequent advocacy of flood geology by Seventh-Day-Adventist geology enthusiast George McCready Price in the 1920s; and (2) the Price-inspired revival among fundamentalists and evangelicals highlighted by Whitcomb and Morris' *The Genesis Flood*[3] and related works in the 1960s and following. A chronologically intermediate figure, Lutheran pastor Byron Nelson, writing his 1931 *The Deluge Story in Stone*,[4] revived the living fossil argument, quoting a 1695 John Woodward treatise extensively. Nelson then introduced the trilobite as a likely candidate for rediscovery in the deep sea. He wrote:

> Modern oceanographers confess that they have reason to believe that they catch in their nets but the smallest part of the forms of life which are in the depths of the sea. There may now dwell the Trilobites … whose remains are so abundant in the strata of many parts of the world, and which *are supposed by modern geologists to have evolved and died out* in the very earliest ages (emphasis mine).[5]

Likewise, a caption to a figure apparently showing Burgess Shale arthropods reads:

> Fossil trilobites from a stratum in the mountains of British Columbia. These creatures are *supposedly extinct* but may live abundantly at present in the depths of the seas (emphasis mine).[6]

Whitcomb and Morris echoed Nelson's use of the trilobite. Their timing was fortuitous. Among the American public, awareness of the "living fossil" phenomenon had been heightened by the discovery in China in 1944 of the Dawn Redwood *Metasequoia*, at just the time that prominent scientists were agitating for the preservation of the California Redwoods. The explosion in oceanographic research that followed WWII, revealing for the first time the topography and fauna of the deep sea was also stoking popular imagination. The discovery of the coelacanth, a lobe-finned fish believed to be closely related to the ancestors of amphibians, was a low-tech affair based on a fisherman's 1938 catch. Marine expeditions in the mid-twentieth century, however, brought new shipboard and submarine technology to the search. The year 1952 marked the discovery of *Neopilina,* a genus of the monoplacophoran mollusks, a group thought to be extinct for hundreds of millions of years.

In a section on Living Fossils, Whitcomb and Morris described the beakhead reptile *Tuatara*, the coelacanth, and *Metasequoia*, all to advance the implication that the appearance of a change in life through time may be an artifact of ignorance. Species deemed extinct may just be not-yet-found. And thus they re-introduced the trilobite:

> It would not be surprising if even the famous trilobite, perhaps the most important "index fossil" of the earliest period of the Paleozoic, the Cambrian, should turn up one of these days. A creature very similar to it has already been found.[7]

Whitcomb and Morris did not credit Nelson with this idea; although clearly aware of his writings, they may or may not have recalled his use of the trilobite in this context. But Whitcomb and Morris were armed with news. They cited the popular science magazine *Science Digest*'s account of the discovery of a living fossil so similar to the trilobite that, according to the magazine, it was stimulating hopes of finding extant trilobites.[8]

Popular science magazines, like the mass media generally, often pick up stories from scientific meetings or journals and popularize them with a "spin" they think to be of interest to the readership. The primary literature on which the extremely brief and non-illustrated *Science Digest* items were based was not cited by Whitcomb and Morris, but it indeed was related to an important discovery: the location and first description, in 1954, of the Cephalocarida, a previously-unknown subclass of crustacean arthropods.[9]

Crustaceans are not trilobites, although both are arthropods. Multiple paired, jointed appendages are common to all arthropods. Compared with members of the extinct Trilobita, each group within the Crustacea generally have a unique suite of limbs, some of which have specialized functions (anten-

nules and antennae for sensing; mandibles for biting; maxillae for food manipulation, and so on), although there is some variation among groups, especially in the posterior limbs.[10] Trilobites, by contrast, though morphologically diverse in many other ways, had remarkably generalized limbs; except for a single pair of antennae, the limbs are nearly identical in form to each other.[11] Most free-living crustaceans have an exoskeleton wrapping around the soft parts dorsally and laterally; many have a narrow, elongate shape. In contrast, trilobites were flattened, ovoid, covered only dorsally by a carapace, which is differently divided than that of crustaceans. Where eyes are present, the crustacean eye differs from the trilobite eye.

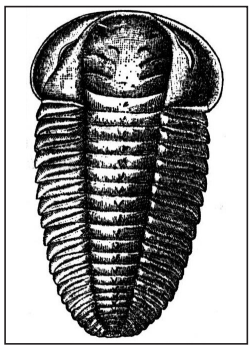
Whitcomb and Morris [in 1961] echoed Nelson's use of the trilobite. Their timing was fortuitous.

If trilobites and crustaceans were so different, why would the discovery of a new crustacean evoke comment on trilobites? As with any extinct group, attempts to understand the trilobites' functional morphology and mode of life depend on parallels drawn from similar, but extant, forms—usually found among their closest living relatives.[12] For trilobites, the choices for such analogies would include certain crustaceans and the Xiphosura ("horseshoe crabs"), members of yet another arthropod group. (Debates about whether trilobites are more closely related to crustaceans or to horseshoe crabs are long-standing and unresolved.) Given the unspecialized limbs of trilobites, interest focuses on those modern arthropods with the most "generalized" morphology—especially with respect to limbs.[13] Among the Crustacea, the best candidates are the Cephalocarida, the Anostraca, and the Remipedia.[14] Discovery of the "simple" cephalocarids, with their generalized morphology and horseshoe-shaped head shield, thus provided another possible analogue for trilobite function. Of course, there are many differences: almost all cephalocarids are eyeless, while most trilobites had eyes; cephalocarids are long and slender, have many trunk segments, and are significantly smaller (between two and four millimeters, compared with trilobites that averaged a few centimeters, with a few reaching half a meter). The size is particularly significant because of the implications for their function in feeding and locomotion. For example, at such tiny limb sizes, the ratio of inertial to viscous forces renders cephalocarids unable to swim actively. In fact, it was probably the small size, as much as the depth at which they were first found, that made the cephalocarids "elusive."

So here is the genealogy of an enduring trilobite "urban legend." Oceanographers discovered a new taxon of crustaceans, the Cephalocarida, which they duly reported in the professional literature. Arthropod specialists were quick to recognize the value of a model for a "primitive" crustacean. Writers of a popular science magazine, who played up the sensational connection in two one-or-two paragraph "page filler" items, noticed analogies between the new taxon and a different class of arthropods, the well-known fossil group of trilobites. They used the term "living fossil," even though the case to which they referred did not carry the usual meanings of a living fossil: cephalocarids had no fossil record, and trilobites were (and still are!) extinct. Whitcomb and Morris picked up the story, probably from *Science Digest* (if they were aware of the scientific source, they did not cite it; alternatively, they did not cite it because it makes no reference to trilobites at all.) Whitcomb and Morris featured the tiny popular items, thus keeping the "living fossil" moniker attached to trilobites. Their discussion linked discovery of a "living fossil" to Nelson's (and more distantly, Woodward's) prophecy, by repeating the *Digest*'s claim that scientists are hot on the trail of the living trilobites. Works of "scientific creationists"[15] continued to repeat the possibility of finding living fossils like trilobites, which are "*presumably* extinct," without alerting readers to the Crustacean affinities of the discovered taxon or subsequent research on it.

They cited the popular science magazine Science Digest*'s account of the discovery of a living fossil so similar to the trilobite that, according to the magazine, it was stimulating hopes of finding extant trilobites.*

Repetition by popular speakers keeps the misunderstanding alive. Possibility can even morph into certitude with distance, as Morris claimed as recently as 2000: "Other famous living fossils include the tuatara … and even the trilobite (chief index fossil of the even more ancient Cambrian Period)."[16]



As a varied and fascinating group with an extensive fossil record, and as a "charismatic" animal with popular name recognition, trilobites themselves are symbols of evolutionary life history.

Contemporary "scientific creationists" may continue using the rhetoric of suspicion regarding trilobite biostratigraphy, even when correctly describing trilobite morphology. For example, DeYoung as recently as 2002 repeats published details of visual systems in the trilobite *Phacops rana* to support his own inferences:

> Yet this creature *supposedly lived during the Paleozoic Era,* … trilobites are *considered to have been an index fossil* … this *theoretical ancient time span* is *assumed* to have elapsed before the dinosaurs came into being … (emphases mine).[17]

Trilobite visual systems are indeed amazing, and the objective morphologic details cited by DeYoung are accurately reported; but they have no bearing on trilobites' utility as index fossils, their antiquity, or their stratigraphic position relative to dinosaurs.

Why is there interest in trilobites and extinction in "scientific creationist" literature? As a varied and fascinating group with an extensive fossil record, and as a "charismatic" animal with popular name recognition, trilobites themselves are symbols of evolutionary life history. Sowing doubt about the extinction of trilobites might seem to put evolution in a more suspicious light. If purportedly extinct taxa are actually or potentially "living fossils," they reason, is extinction a pseudo-phenomenon? If life history consists of numerous originations and extinctions, has the "extinction" side been exaggerated, or can it be lightly regarded? Huge numbers of extinct taxa belie this possibility. To claim immanent discovery of tens of thousands of forms strains credulity. Still, any fossil organism literally *could* be found extant at any time. My toe is still in the surf, waiting to be bitten. ⁂

Notes

[1]Martin J. S. Rudwick, *The Meaning of Fossils* (Chicago: University of Chicago Press, 1976).
[2]Roland L. Numbers, *The Creationists* (Berkeley, CA: University of California Press, 1991).
[3]John Whitcomb and Henry H. Morris, *The Genesis Flood* (Phillipsburg, NJ: Presbyterian and Reformed Publishing, 1961).
[4]Byron C. Nelson, *The Deluge Story in Stone* (Minneapolis, MN: Bethany, 1931).
[5]Ibid., 32.
[6]Ibid., 33.
[7]Whitcomb and Morris, *The Genesis Flood*, 179.
[8]The two items from *Science Digest* are each bottom-of-the-page magazine "filler" items with no author listed. They do not appear in the indexes at the front of the monthly issues, but do appear in the annual indexes for their respective years: "'Living Fossil' Resembles Long-Extinct Trilobite," *Science Digest* 42 (Dec. 1957): 59; and "Start Search for Living Trilobites," *Science Digest* 46 (Aug. 1959): 81. The latter item is incorrectly referenced in Whitcomb and Morris as appearing in September 1959, p. 81 (no volume number given.) Some awkward changes in the magazine's numbering system probably caused the confusion.
[9]Howard L. Sanders, "The Cephalocarida, a New Subclass of Crustacea from Long Island Sound," *Proceedings of the National Academy of Sciences* 41 (1954): 61–6.
[10]Richard C. Brusca and Gary J. Brusca, *Invertebrates: Phylum Arthropoda: The Arthropod Bauplan and the Trilobites* (1990): 461–92; *Phylum Arthopoda: The Crustaceans* (1990): 595–770. I have minimized the use of taxonomic ranks within the text because of variation in their use. Brusca and Brusca's usage is common: The Subphylum Crustacea has numerous classes, including the Class Remipedia, Class Cephalocarida, and Class Branchiopoda, which includes the Order Anostraca. The Order Xiphosura belongs in the Subclass Merostomata and the Class Chelicerata. Trilobites are placed in the Subphylum Trilobitomorpha.
[11]H. B. Whittington, "Morphology of the Exoskeleton: The Trilobite Body," in H. B. Whittington, et al, *Arthropoda 1: Trilobita*, Revised: *Treatise on Invertebrate Paleontology Part O* (Boulder, CO: Geological Society of America, 1997), 1–132. Contemporary paleontological usage, for which the *Treatise* is authoritative, places trilobites in the Class Trilobita but discourages the use of Trilobitomorpha.
[12]Matthew A. Wills, "Crustacean Disparity Through the Phanerozoic: Comparing Morphological and Stratigraphic Data," *Biological Journal of the Linnean Society* 65 (1998): 455–500.
[13]I have avoided cladistic vocabulary because of its technical nature. In cladistic terminology, the concept here represented as "generalized arthropods" would be better expressed as "living plesiomorphic representatives of the aquatic clades" (Derek E. G. Briggs and Richard A. Fortey, "The Early Radiation and Relationships of the Major Arthropod Groups," *Science* 246 [1989]: 241–3).
[14]The Remipedia, latest darlings of the "urcrustacean" set, was first described in 1981. They are even "simpler" than cephalocarids—they lack any trunk tagmosis (J. Yager, "Remipedia: a New Class of Crustacea from a Marine Cave in the Bahamas," *Journal of Crustacean Biology* 1 [1981]: 328–33).
[15]Henry Morris, ed., *Scientific Creationism* (San Diego, CA: Creation-Life, 1974), 88–9.
[16]Henry H. Morris, "The Profusion of Living Fossils," *Acts and Facts* 29, no. 11 (2000): Online Issue no. 3.
[17]Don B. DeYoung, "Vision," *Creation Research Quarterly* 38 (2002): 190–2.

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